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Abstract

This paper discusses the difference between computing-related addictions and high engagement in computing activities. The results of two studies are reviewed, one involving factor analysis of paper questionnaire items concerning computing in general, and one involving web-based questionnaire items concerning a Massively Multiplayer Online Role-Playing Game. Across both data sets, it is shown that items tapping euphoria, cognitive salience and tolerance appear to indicate high engagement (a high degree of non-pathological involvement) rather than addiction. It is therefore suggested that these criteria, which have been used to classify pathological gambling behaviours, should not be adapted for use in classifying pathological computing behaviours, as has sometimes been done. It is argued that, while thoughts and behaviours surrounding computing may occupy a large amount of the time of people who are highly engaged with a computing activity, this cannot be considered pathological in the absence of deleterious effects on their lives. It is shown that including these types of criteria in schemes to classify people as addicted can lead to over-estimates in the number of people who are addicted to any particular computing activity. On the other hand, it is argued that people whose behaviours lead to interpersonal conflict, who experience withdrawal symptoms when not performing an activity, whose attempts to curtail their behaviour end in relapse and reinstatement, and whose behaviours result in self-neglect can be considered to be addicted to a computing activity.
Keywords: computer addiction, computer dependence, impulse control disorders, computer attitudes, computer games, Internet, taxonomies.

1 Introduction

In the past ten years much work has appeared suggesting that addiction to computing activities, particularly Internet-mediated activities, may be a cause for concern. In this paper we discuss two studies with implications for classification procedures used in some of this work. But, before considering these issues, it is worth mentioning that the very idea that computer-related addictions may exist is controversial. Here, it has been argued that using the term 'addiction' in connection with non-chemically-related behaviours may be seen to trivialize chemical addictions (Jaffe, 1990). However, recently developed brain scanning techniques have revealed close similarities between the brain's responses to rewards irrespective of whether these stem from ingesting substances or other behaviours (Holden, 2001). Another controversy concerns terminology. The revised fourth edition of the American Psychiatric Association's Diagnostic and Statistical Manual (DSM-IV-TR) refers to conditions where people are unable to desist from behaviours resulting in self-harm or harm to others, but which do not involve ingestion of substances, as impulse-control disorders (APA, 2000). Even in connection with drug use the DSM-IV-TR uses the phrase 'dependence' rather than addiction because the latter has become pejorative. Nevertheless, in discussing non-substance-related behavioural phenomena, Brown (1991) argued that the term 'addiction' is still useful, and the term is adopted here given the centrality of Brown's work to the studies described.

Among the first people to voice a concern that people may be interacting with computers to an undesirable extent was Shotton (1989) who performed a study of what she termed computer dependent individuals. She defined dependency in terms of an individual's '…strong compelling desire…' to use computers (p.5). However, in the main, the behaviour of Shotton's dependents appeared non-pathological since they experienced few negative consequences of their behaviours, such consequences being widely accepted as critical in defining pathologically excessive behaviours (e.g. DSM-IV-TR). Similarly, Griffiths and Hunt (1998) identified few negative effects of the behaviours of adolescent computer game players whom they labelled as dependent based upon criteria adapted from those in the DSM-III-R for the impulse control disorder of pathological gambling. Such a classification scheme (from DSM-IV) was also used in Young's (1996) study of Internet addiction, which was criticised by Beard and Wolf (2001) on these grounds. Taking into account studies such as these, we asked whether some studies may confuse pathological behaviours with highly-zealous but non-pathological behaviours.

Many of the DSM criteria used in the above studies are reflected in Brown's (e.g. 1991) criteria for behavioural addiction, and Griffiths (e.g. 1996) has used Brown's criteria in discussing technological addictions. The present research focussed upon Brown's criteria as used by Griffiths, rather than criteria adapted from the DSM's conception of pathological gambling, because the

former aim to cover all behavioural addictions and therefore represent a particularly plausible scheme for classifying computer-related behaviours.

Griffiths (1996) summarised four of Brown's six criteria as follows; euphoria (the activity produces a 'buzz' or a 'high'); tolerance (the activity has to be engaged in to an increasingly greater extent to acquire the same 'buzz'); withdrawal symptoms (negative emotions or physical effects are experienced on cessation of the activity); relapse and reinstatement (resumption of the activity with the same vigour after attempts to abstain). The other two criteria are multi-faceted. First, conflict can take the form of inter-personal conflict as a result of performing the activity, intra-psychic conflict where internal conflict results from one's behaviour, and finally conflicts with other activities, where behaviour involving the object of addiction is preferred over activities such as work and socialising (Griffiths, 1998). Second, salience can consist of cognitive salience, where an activity dominates a person's mental life, and / or behavioural salience, where an activity dominates a person's behaviour (Brown, 1991; Griffiths, 1996). Brown's scheme is monothetic: an individual has to meet all six criteria for a positive classification to be made. This can be contrasted with polythetic schemes, such as those used in the previously mentioned DSM-based studies, where only a proportion of criteria have to be met for a positive classification.

Behavioural addiction can be contrasted with high engagement. The latter does not necessarily entail any lesser involvement in terms of the amount of time an individual devotes to an activity, but differs from addiction in that negative consequences are absent and in that there is no compulsion to perform the activity to alleviate dysphoria upon its discontinuation. Rather, the highly engaged person performs an activity because they find it enjoyable. High computer engagement can be a positive quality, being positively related to students' academic performance on a programming-orientated computing course (Charlton & Birkett, 1999).

The two studies reviewed here sought to differentiate facets of computer-related addiction from facets of high engagement. Towards this end, the suitability of Brown's behavioural addiction criteria for classifying people as having computer-related addictions was considered. A factor analytic approach was adopted, questionnaire responses to items tapping addiction and engagement being analysed. The first study considered computing in general, collecting responses to items on a paper questionnaire. The second study replicated and extended the first. Players of a specific type of putatively addictive Massively Multiplayer Online Role-Playing Game (MMORPG) were targeted via a website, and questionnaire items were altered to refer to the game at issue. Across both studies, it was reasoned that if it is appropriate to use Brown's criteria, and related DSM criteria, in classifying computer-related addictions, an Addiction factor should load more highly than an Engagement factor upon items tapping these criteria. If this was not the case, it was envisaged that this would necessitate re-assessment of the criteria used in defining computing-related addictions. Brief attention was also paid to the possibility that a developmental process may exist whereby people pass through a stage of high engagement prior to becoming behaviourally addicted to computing activities.

2 Method

Study 1 (reported more fully in Charlton, 2002) involved distributing a 47 item paper questionnaire to 404 students on courses at a higher education institution in northern England (193 males and 198 females, both genders having a mean age of around 26 years and SD around 9 years). The questionnaire contained a mixture of positively and negatively phrased statements seeking to tap Brown's addiction criteria (see Table 1), other addiction-related items (e.g. 'I think that I am addicted to computing'), items tapping computer apathy-engagement (e.g. 'I would hate to go without using a computer for more than a few days') and computer comfort-anxiety (e.g. 'I find computers threatening'). The majority of these two latter types of item were taken from the Computer Apathy and Anxiety Scale (Charlton & Birkett, 1995 – apathy and engagement constitute opposite ends of the same continuum). All items were statements concerning computing-related behaviours and cognitions in general, rather than any specific type of computing activity. Participants responded to statements on a five-point Likert-type scale with response options ranging from Strongly Disagree to Strongly Agree. To encourage participation, students completing questionnaires were entered in a raffle for prizes totalling £60 in cash.

Table 1: Items tapping Brown's criteria for behavioural addiction (italicised and parenthesised wordings are for Study 1 and Study 2 items respectively).

A1:	**Salience (cognitive);** I rarely think about *computing* (playing Asheron's Call) when I am not using a computer.
A2:	**Salience (behavioural);** I never miss meals because of *my computing activities* (playing Asheron's Call).
A3:	**Salience (behavioural);** I often fail to get enough sleep because of *my computing activities* (playing Asheron's Call).
A4:	**Euphoria;** I often experience a buzz of excitement while *computing* (playing Asheron's Call).
A5:	**Tolerance;** I tend to want to spend increasing amounts of time *using computers* (playing Asheron's Call).
A6:	**Withdrawal symptoms;** When I am not *using a computer* (playing Asheron's Call), I often feel agitated.
A7:	**Conflict (inter-personal);** Arguments have sometimes arisen at home because of the time I spend *on computing activities* (playing Asheron's Call).
A8:	**Conflict (with other activities);** My social life has sometimes suffered because of my *computing activities* (playing Asheron's Call).
A9:	**Conflict (with other activities);** *Computing activities have* (Playing Asheron's Call has) sometimes interfered with my work.
A10:	**Relapse and reinstatement;** I have made unsuccessful attempts to reduce the time I spend *computing* (playing Asheron's Call).

In Study 2 (described more fully in Charlton & Danforth, 2004), 442 players of a MMORPG entitled Asheron's Call responded to a 29 item questionnaire placed on a website devoted to the game (http://ac.xrgaming.net). Respondents were 379 males (mean age around 29 years, SD around 9 years) and 61 females (mean age around 33 years, SD around 8 years). The questionnaire contained the same basic addiction and apathy-engagement items as in Study 1. However items were modified to be specific to Asheron's Call. The equivalent items tapping Brown's addiction criteria are shown in Table 1. In this study computer comfort-anxiety items were omitted, and participants responded on a seven-point Likert-type scale with responses ranging from Completely Disagree to Completely Agree. The number of points on the response scale was increased relative to Study 1 to produce greater variability in the data. As an incentive to take part, respondents were entered into a raffle with a prize of two months free game play (value US $26).

3 Results

In both studies scree plots from initial Principal Components Analyses were used to select the number of components present. These plots revealed three components in Study 1 and two in Study 2. Principal Axis Factoring with oblique (Direct Oblimin) rotation was then performed. For both studies these solutions are reported since factors were moderately correlated (e.g. .38 in Study 1 for the two factors of major interest and -.33 in Study 2; the latter correlation was negative because of a reversal in polarity of one factor's loadings).

The Study 1 solution accounted for 43% of item variance. Based upon the factor pattern loadings, factors were interpreted as Computer Engagement (accounting for 28% of item variance), Computer Addiction (11% of variance), and Computer Comfort (4% of variance). In Study 2, 32% of item variance was accounted for. Here factors were interpretable as Asheron's Call Addiction (25% of item variance) and (Low) Asheron's Call Engagement (7% of variance). Addiction and Engagement factor pattern loadings for the 10 items tapping Brown's behavioural addiction criteria across both studies are given in Table 2.

Table 2 shows that in both studies the Engagement factor loaded more highly than the Addiction factor upon items tapping Brown's euphoria and tolerance criteria. The same was also true for the cognitive salience item, but not the behavioural salience items. As far as the main point at issue is concerned then, both studies showed that some of the criteria previously taken as being indicative of addiction appear to be more related to high engagement (a non-pathological construct) than addiction. These criteria are subsequently referred to as peripheral criteria. Across both studies the Addiction factors loaded highly upon items tapping the remainder of Brown's criteria (withdrawal, relapse and reinstatement, behavioural salience, and conflict – both inter-personal and with other activities). Henceforth, these are referred to as core criteria.

Table 2: Factor pattern loadings for items tapping Brown's behavioural addiction criteria across the two studies.

Item	Study 1		Study 2	
	Addiction	Engagement	Addiction	Engagement
A1 Cognitive Salience	-.31	-.41	-.27	.49
A2 Behavioural Salience (meals)	-.49	-.05	-.46	-.03
A3 Behavioural Salience (sleep)	.73	-.01	.53	-.17
A4 Euphoria	.39	.43	.13	-.40
A5 Tolerance	.36	.55	.36	-.42
A6 Withdrawal	.49	.10	.62	-.07
A7 Conflict (inter-personal)	.67	-.02	.54	-.11
A8 Conflict Activities (social)	.72	-.07	.69	-.02
A9 Conflict Activities (work)	.63	-.03	.66	.06
A10 Relapse & Reinstatement	.58	-.10	.62	.08

For the most part the results of the two studies were highly similar. For example, calculation of Pearson's *r* coefficients across the pairs of Addiction and Engagement factors in the two studies revealed a value of $r = .96$ ($df = 8$, $P < .001$ one-tailed) for the Addiction loadings and of $r = -.93$ ($df = 8$, $P < .001$ one-tailed) for the Engagement loadings (these loadings were negatively correlated because of the differences in algebraic signs of the loadings for this factor in the two studies). However, there were some minor differences. In particular, taking loadings greater than +/-.32 as high, in Study 1 both the euphoria and tolerance items were complex, with both the Engagement and Addiction factors loading highly upon them, albeit that the former factor loaded more highly. But in Study 2 the euphoria item was factor pure, only the Engagement factor loading highly.

To clarify implications for classification systems, consideration was given to frequencies of responses relevant to classification decisions. To do this, in each study the original Likert-scale responses were dichotomised for each of the 10 relevant items into those falling on the side of the response scale indicating some extent of agreement and those falling on the side indicating some extent of disagreement (mid-scale responses were excluded). Then frequencies of responses on the side of the scale consistent with an 'addicted' response were counted for each item. These frequencies are shown in Figure 1. Here it can be seen that across both studies, in the main, the peripheral criteria (the first three items represented on the figure) tended to be endorsed more frequently than the core criteria. To investigate further, the extent of joint endorsement of the peripheral and core criteria was examined. To simplify matters, people were split into those endorsing low (0 and 1) and high (2 and 3) numbers of peripheral criteria, and low (0 through 3) and high (4 through 7) numbers of core criteria. These frequencies were cast into 2 x 2 contingency tables. Inspection of frequencies indicated that students giving a high number of core responses also tended to give a high number of peripheral responses (in Study 1 54.17% of students giving a high number of core responses also gave a high number of peripheral responses, while the corresponding percentage in Study 2 was 84.62% of game players). Given that the addiction and engagement

factors were correlated in both studies, these observations were not surprising (therefore chi-square test results, both of which were significant, are not presented). Nevertheless, as will be discussed, this limits the implications for classification decisions of the factor analytic findings and the finding that people generally endorsed more peripheral than core criteria.

To consider whether a developmental process may exist whereby high engagement is a precursor of addiction, McNemar's Change Tests were performed on the numbers of people endorsing a high number of peripheral items but a low number of core items compared with the numbers of people endorsing a high number of core items but a low number of peripheral items. Evidence for a developmental process would consist of the former people outnumbering the latter. In both studies such evidence existed. Thus, in Study 1 12.13% of people (n=49) fell into the first category and 2.72% fell into the second category (n=11) resulting in a value of χ^2=24.07 (df =1, P<.001), and in Study 2 49.55% of people (n=219) fell into the first category and 3.17% fell into the second category (n=14) resulting in a value of χ^2=180.36 (df =1, P<.001).

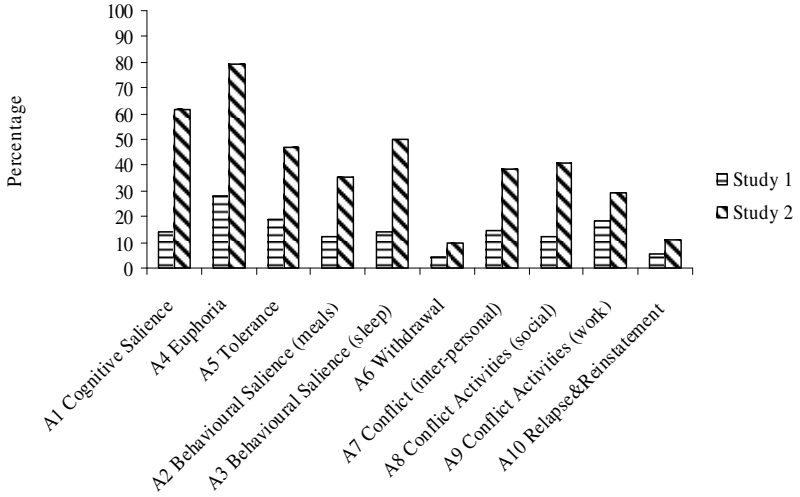

Figure 1: Frequency of endorsement of items across the two studies.

4 Discussion

The present studies show that the criteria of euphoria, tolerance and cognitive salience are not central to the definition of computer-related behavioural

addictions and that it is doubtful whether they should be used in classifying people as addicted to computing–related activities. On the other hand, the criteria of relapse and reinstatement, withdrawal, behavioural salience and conflict do cluster together as a group of addiction criteria and are likely to be central in the classification of computing-related addictions. These results support some of Beard and Wolf's (2001) criticisms of Young's (1996) use of adapted DSM pathological gambling criteria in studying Internet addiction. Here it was argued that preoccupation with an activity (cognitive salience) and wanting to spend increasing time on it (tolerance) are not necessarily characteristics of Internet addiction, and our results support this contention. However, our results do not support Beard and Wolf's contention that the same can be said for unsuccessfully reducing a behaviour (relapse and reinstatement), and experiencing negative psychological effects when not engaging in a behaviour (withdrawal symptoms). Our findings also suggest a possible need to revise the content of some questionnaires used to study Internet addiction / impulse control problems (e.g. Brenner, 1997; Davis, Flett & Besser, 2002; Morahan-Martin & Schumacher, 2000), since they may contain a mixture of core and peripheral items (this is discussed at greater length in Charlton & Danforth, 2004).

The implications of the studies can be clarified at a more detailed level by considering the percentages of people who could be said to be addicted / dependent under different classification schemes in the present studies and Griffiths and Hunt's (1998) study (see Table 3). Looking at the first column of Table 3, note that the percentage of people classifiable as addicted based upon their endorsement of 50% of the criteria set out in each study (4 out of 8 in Griffiths and Hunt's study, and 5 out of 10 in the present two studies) is greater in our Study 2. This can be attributed to the fact that the latter study used a recruitment method (placing a message on a web site devoted to Asheron's Call) that tapped into a pool of people which was likely to contain a higher number of candidates for an addiction classification than the Griffiths and Hunt study (adolescent computer game players in a British secondary school), or our Study 1 (British higher education students). This illustrates the obvious point that one has to consider the characteristics of the population sampled when drawing conclusions as to the prevalence of any addiction.

Table 3: Percentages (and numbers) of people classifiable as addicted using various classification schemes.

Study	50% of peripheral and core criteria	50% of core criteria	All Brown criteria
Griffiths & Hunt	16.0 (62/382)	----	----
Study 1	8.4 (34/404)	8.4 (34/404)	0.0 (0/404)
Study 2	38.7 (171/442)	28.7 (127/442)	1.8 (8/442)

Other statistics (not presented for brevity) showed that in Study 1 almost two thirds of people exceeding the 50% cut-off at which an addiction classification might be made only did so because they endorsed criteria more indicative of engagement than addiction, and this rose to almost three quarters in

Study 2. However, the second column of Table 3 shows that the number of people in Study 1 who would be considered addicted based upon their endorsement of 50% of the core criteria alone (all those endorsing four or more of the core criteria plus, to enable comparison and because 3.5 criteria would constitute a 50% cut-off, half of those who endorsed 3 core criteria) was exactly the same as that for a 50% cut-off involving both the peripheral and core criteria. On the other hand, the same comparison for Study 2 showed a 10 percentage point decrease in the number of people classifiable as addicted on the basis of core criteria alone. This difference across the two studies can be attributed to a greater degree of endorsement of the peripheral criteria relative to the core criteria in Study 2, the removal of the peripheral criteria from the classification scheme thereby having a greater impact in this study. Taken together, these observations show that the implications of the findings that some previously used addiction criteria signal engagement and that people meet these peripheral criteria more frequently than the remaining core criteria, are limited by the fact that people who endorse a large number of core criteria are also likely to endorse peripheral criteria. The distinction between the two types of criteria has minimal implications for the classification of such individuals: they would be classified as addicted whether or not a scheme includes peripheral criteria. However, the implications for the classification of people near the borderline of an addiction classification by virtue of their endorsement of a lower but moderate number of core criteria are greater, at least where an activity has addictive properties as in Study 2: if these people also endorse (peripheral) criteria signalling high engagement they are at risk of being erroneously classified as addicted.

Remembering that Brown (e.g. 1991) originally advanced a monothetic scheme, the final column of Table 3 shows that adoption of a more stringent scheme requiring endorsement of all Brown's criteria leads to a vast reduction in the number of putative addicts relative to either of the polythetic schemes.

To conclude, it seems that some criteria previously used to classify people as behaviourally addicted to computing activities are more indicative of non-pathological high engagement. Mistaking criteria signalling high engagement for addiction criteria can lead to inflated estimates of the number of people who may be addicted to an activity, particularly where polythetic classification procedures are used and an activity has addictive properties as in Study 2. The findings are also important for theory surrounding computer-related addictions in particular and behavioural addictions in general. For example, while a longitudinal study would be more definitive, the observations in both studies that the number of people endorsing a high number of peripheral items but a low number of core items was greater than the number of people endorsing a high number of core items but a low number of peripheral items suggested a possible aetiological process whereby high engagement is a precursor of behavioural addiction to computing activities.

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